

Management of Temporomandibular Joint Ankylosis



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KEYWORDS

- Temporomandibular joint • Ankylosis • Total joint replacement • Autologous fat grafting

KEY POINTS

- Trauma is the most common cause of TMJ ankylosis, followed by infection.
- TJR should be considered as the initial treatment modality for management of TMJ ankylosis.
- The use of patient-fitted or stock prostheses reduces operative time, there is no potential donor site morbidity, and the patient can immediately return to function.
- Consider TJR in children with failed, overgrown, or ankylosed CCG grafts.
- Autologous fat grafting is a very useful adjunct to alloplastic TMJ TJR, which can reduce the chance of heterotopic bone formation around the fossa.

INTRODUCTION

Temporomandibular joint (TMJ) ankylosis is a pathologic condition where the mandible is fused to the fossa by bony or fibrotic tissues. This interferes with mastication, speech, oral hygiene, and normal life activities, and can be potentially life threatening when struggling to acquire an airway in an emergency. Attempting to open the mouth, stretching the periosteum, can also result in pain.¹

There are multiple factors that can result in TMJ ankylosis, such as trauma, arthritis, infection, previous TMJ surgery, congenital deformities, idiopathic factors,² and iatrogenic causes. Trauma is the most common cause of TMJ ankylosis, followed by infection.^{3,4} TMJ ankylosis in growing patients can result in dentofacial deformity.⁵

Diagnosis of TMJ ankylosis is usually made by clinical examination and imaging studies, such as plain films, orthopantomograms, computed tomography (CT) scans, MRI, and three-dimensional reconstruction.⁶ Sawhney⁷ and He

and colleagues⁸ proposed classification systems for TMJ ankylosis (**Fig. 1**).

The management goal in TMJ ankylosis is to increase the patient's mandibular function, correct associated facial deformity, decrease pain, and prevent reankylosis. Multiple surgical modalities have been proposed to manage TMJ ankylosis including gap arthroplasty, interpositional arthroplasty, and total joint reconstruction (TJR). Autogenous tissues, such as ear cartilage, temporalis muscle flap, dermis, fat, and bone, have been used or after gap arthroplasty (**Fig. 2**).^(refs?) Alloplastic materials, such as Proplast Teflon (Vitek, Houston, TX) and Silastic (Dow, Corning, Midland, MO), have also been used, but with high failure rates.⁹⁻¹²

TJR can be divided into autogenous replacement, such as costochondral (CCG) and sternoclavicular grafts (SCG); microvascular reconstruction; or alloplastic replacement (**Fig. 3**).¹³⁻¹⁷ CCG has been reported to have unpredictable results in TMJ reconstruction.¹⁸⁻²¹ The common postoperative complications include reankylosis, resorption,

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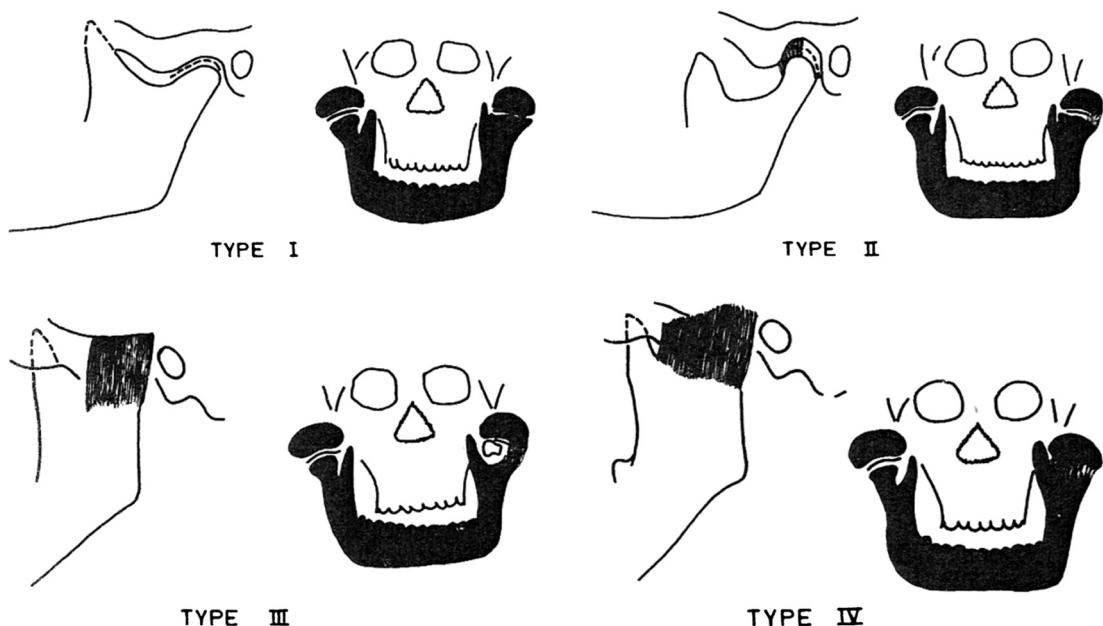


Fig. 1. (Type I) The head was flattened or deformed by lying closely approximated to the upper articular surface. There were dense fibrous adhesions all around the joint, making movement impossible. This probably followed a comminuted fracture of the head of the mandible. (Type II) The head was misshaped or flattened, but it was still distinguishable and lay in close approximation to the articular surface. There was, however, bony fusion of the head to the outer edge of articular surface either anteriorly or posteriorly, but this was limited to a small area. Deeper to it, the upper articular surface and the articular disk were undamaged. This probably followed a severe comminuted fracture of the head with associated partial damage to the upper articular surface. (Type III) A bony block was seen to bridge across the ramus of the mandible and the zygomatic arch. The upper articular surface and the articular disk on deeper aspect were intact. The displaced head was seen to be atrophic and lying either free or fused with the medial side of the upper end of the ramus. This probably followed a severe injury producing fracture dislocation of the head and neck of the mandible and laceration of capsular ligaments. (Type IV) The bony block was wide and deep and extended between the ramus and the upper articular surface, completely replacing the architecture of the joint. This perhaps followed fracture of the neck of the mandible with dislocation of the head and associated injury to the capsular ligaments, articular disk, and even the upper articular surface. This was the most common presentation. (From Sawhney CP. Bony ankylosis of the temporo-mandibular joint: follow-up of 70 patients treated with arthroplasty and acrylic spacer interposition. *Plast Reconstr Surg* 1986;77(1):32; with permission.)

overgrowth,^{22,23} fracture, and pain. SCGs have growth potential similar to the mandibular condyle and a section of the SCG articular disk can be harvested with the SCG providing the potential for improved function.¹⁶ Distraction osteogenesis has also been used to manage TMJ ankylosis with release of ankylosis before and after the distraction process.²⁴ However, harvesting complications and questionable long-term outcomes must be taken into consideration.

The use of patient-fitted or stock prostheses^{11,25,26} reduces operative time, there is no potential donor site morbidity, and the patient can immediately return to function.²⁷ The disadvantages include cost, difficulty in correction of significant dentofacial deformities, potential material wear, and failure.²⁸ TMJ TJR is thought to be

more costly than autogenous tissue for TMJ reconstruction, but the extra operating room time, personnel, and resources must be considered in the latter scenarios. Also, in view of the potential for increased autogenous tissue donor site morbidity resulting in an increased length of hospital stay and the unpredictable nature of the results of autogenous tissue grafting, the economic impact of TMJ TJR is likely less overall. Furthermore, because patient-fitted TMJ TJR components are designed "made to fit," manipulation and implantation time are reduced.

In contrast, with stock TMJ TJR components, the surgeon must "make them fit," requiring increased time and incurring added expense. Wolford and colleagues²⁹ performed a 5-year follow-up of the TMJ Concepts/Techmedica

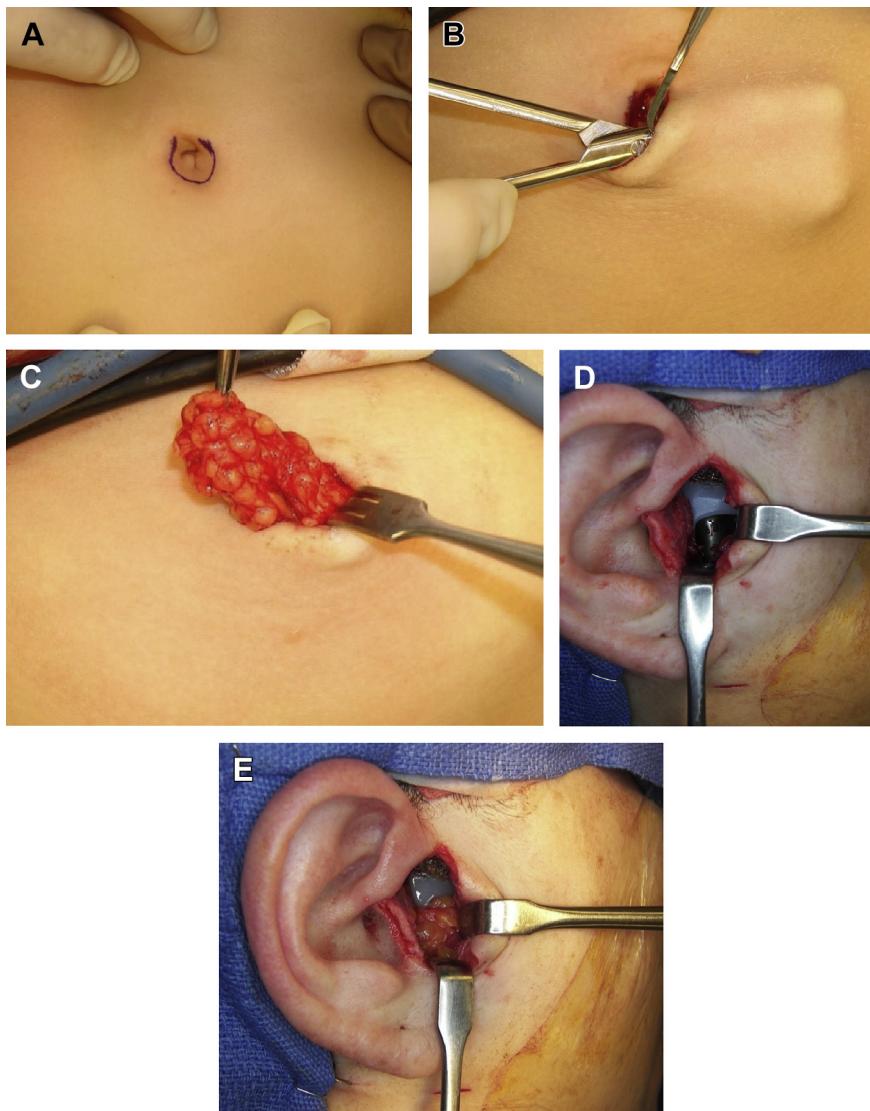


Fig. 2. Images of abdominal fat harvest technique. (A) Marked periumbilical incision for harvest of abdominal fat graft. (B) Undermining of skin and fat before harvest. (C) Composite harvest of abdominal fat. (D) Exposure of graft site for circumferential augmentation of fat graft. (E) Adaptation of fat graft before closure. (Courtesy of Larry Wolford, DMD, Dallas, TX.)

patient-fitted total joint prosthesis (TMJ Concepts Inc., Ventura, CA) with good results. Mercuri and colleagues^{30,31} presented a 9- and 14-year follow-up of the same prostheses with good outcomes.

A basic surgical protocol to address TMJ ankylosis is as follows: release the ankylosed joint; remove the heterotopic and reactive bone with thorough debridement (gap arthroplasty of at least 2.0–2.5 cm), replace the TMJ with a patient-fitted total joint prosthesis, place a fat graft around the articulation area of the prosthesis, and perform indicated orthognathic surgery in a single

operation.^{32–38} Wolford first used this specific surgical protocol for treatment of TMJ ankylosis in 1992.³⁵ The basic protocol can also be performed in two or more surgical stages depending on the surgeon's skills, experience, and preference.

TREATMENT OF TEMPOROMANDIBULAR JOINT ANKYLOYSIS WITH COSTOCHONDRAL GRAFT

The traditional management of complete bony TMJ ankylosis has been gap arthroplasty and autogenous tissue grafting (Fig. 4). Although this

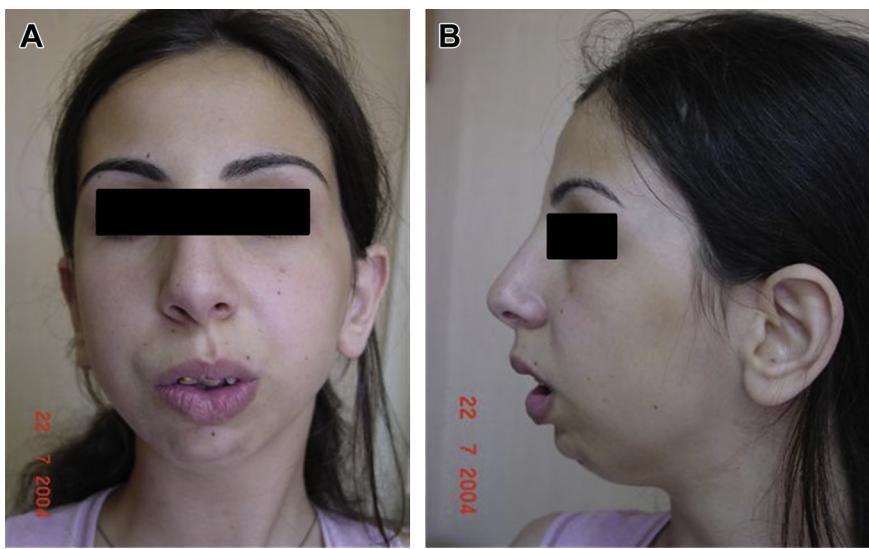


Fig. 3. (A, B) A 20-year-old woman, bilateral TMJ ankylosis status post prepubertal bilateral mandibular condyle fractures. Has had five prior unsuccessful bilateral procedures including costochondral grafts twice, temporalis muscle flaps twice, and coronoidectomies. (*Courtesy of Dr Michael Bowler, Newcastle, New South Wales, Australia.*)

restores form, function is delayed, and therefore potentially compromised. This is the case when autogenous bone grafts are used because of the fear that allowing function of the mandible during the graft incorporation period will cause the graft to fail to vascularize properly. In the patient with re-ankylosis, placing autogenous tissue, such as bone, into an area where reactive or heterotopic bone is forming intuitively makes no sense. Orthopedic surgeons always opt for alloplastic joint replacement in similar situations.³⁶

It has been reported that capillaries can penetrate a maximum thickness of 180 to 220/ μm of tissue, whereas scar tissue surrounding a previously operated joint averages 440/ μm in thickness.²⁷

This may account for the clinical observation that autogenous tissue grafts, such as CCG and SCG, fail in the patient who has undergone multiple operations. Autogenous grafts require a rich vascular host site to survive. The scar tissue that is found in the patient who has undergone multiple operations does not provide an environment conducive to the predictable success of an autogenous tissue graft.

TEMPOROMANDIBULAR JOINT ANKYLOSIS IN GROWING SUBJECTS

Classically, pathologic, developmental, and functional disorders affecting the TMJ in growing

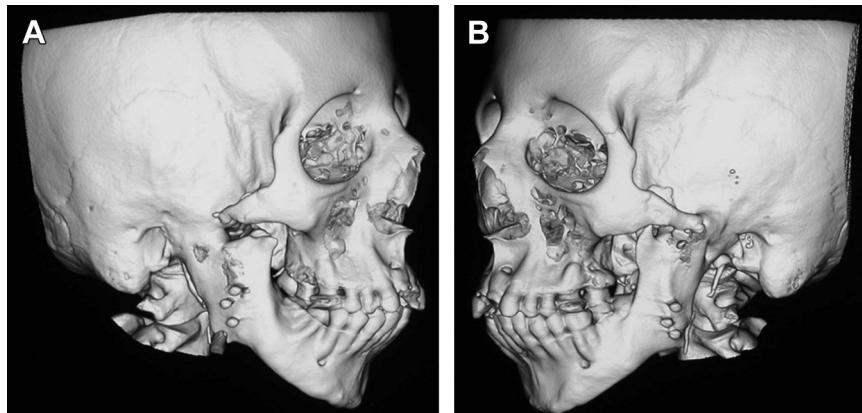


Fig. 4. (A, B) Three-dimensional CT scans of patient in **Fig. 2** demonstrating bilateral complete bony TMJ ankylosis. (*Courtesy of Dr Michael Bowler, Newcastle, New South Wales, Australia.*)

patients have been reconstructed with autogenous tissues. Autogenous CCGs are reported as the gold standard for these TMJ reconstructions.^{37–41}

In theory, in growing patients, autogenous (eg, costochondral) allografts “grow with the patient.” However, often this so-called growth potential has been reported to be unpredictable or to result in ankylosis. These complications can occur either as the result of the allograft and/or fixation failure or because of the uncooperative nature of the young patient with physical therapy after reconstruction.^{15,37,38,42,43}

Recent studies have even questioned the necessity for using a cartilaginous graft to restore and maintain mandibular growth.^{44,45} Long-term reports of mandibular growth in children whose TMJs were reconstructed with CCG show that excessive growth on the treated side occurred in 54% of the 72 cases examined and growth equal to that on the opposite side occurred in only 38% of the cases.^{46–51} Furthermore, Peltonmäki and colleagues,^{52–55} in an investigation of mandibular growth after CCG, supported previous experiments with regard to the inability of the graft to adapt to the growth velocity of the new environment.

Based on the problems that have been reported with CCG TMJ TJR in children, such as graft failure, unpredictable growth, ankylosis, and potential for donor-site morbidity, and the orthopedic experience and success reported with alloplastic TJR in improving the quality of life of growing patients with severe anatomic and functional joint disorders, it seems reasonable to consider examining the feasibility of alloplastic TMJ TJR for the following conditions in children: (1) high inflammatory TMJ arthritis unresponsive to other modalities of treatment; (2) recurrent fibrosis and/or bony ankylosis unresponsive to other modalities of treatment; (3) failed tissue grafts (bone and soft tissue); and (4) loss of vertical mandibular height and/or occlusal relationship because of bony resorption, trauma, developmental abnormalities, or pathologic lesions.

To continue to reoperate in children with failed, overgrown, or ankylosed CCG with either bony or soft tissue replacements (or both), using the same modalities that failed when there may be an appropriate solution available, seems myopic. These patients are better off undergoing alloplastic TMJ TJR knowing that, depending on growth, revision and/or replacement surgery may likely be required in the future, rather than incurring continued failures of CCG that will also likely require further surgical intervention in the future.⁵³

TREATMENT OF TEMPOROMANDIBULAR JOINT ANKYLOSIS WITH TOTAL JOINT RECONSTRUCTION

For the patient with reankylosis, placing autogenous tissue, such as bone, into an area where reactive or heterotopic bone is forming intuitively makes no sense. None of the textbooks of orthopedic surgery or any journal articles published recently discuss the use of autogenous bone in the reconstruction of any joint of a nongrowing patient affected by ankylosis disease. Alloplastic joint replacement is the recommended management modality in orthopedics when total joint replacement is required in such cases.^{56,57}

In light of the biologic considerations and the orthopedic experience, total alloplastic replacement should be considered in the management of recurrent fibrosis and bony ankylosis involving the TMJ.

The protocol CT scan used to generate the stereolithic model from which patient-fitted TMJ TJR components are designed and manufactured has been reported to have a mean dimensional accuracy of 97.9%. Therefore, in the case of ankylosis/reankylosis a two-staged protocol is required when using a patient-fitted TMJ TJR system.⁵⁸

At stage 1 surgery, the surgeon must remove the ankylosis bone, create an adequate gap (2–2.5 cm), and place a material spacer to prevent the reformation of tissue and/or bone (**Fig. 5**).⁵⁹ The patient must be placed into maxillomandibular fixation to prevent movement of the spacer or change in bony architecture and/or occlusion.

A postoperative protocol CT scan is then made and the stereolithic model developed. Patient-fitted TMJ TJR components are designed and manufactured from that model to the specific anatomic circumstances of that case.

At stage 2 surgery, the spacer is removed and the patient-fitted TMJ TJR components are fixated. An autogenous abdominal fat graft is placed around the articulation to inhibit formation of heterotopic bone and development of reankylosis.⁶⁰ The patient can then begin immediate, active postoperative physical therapy. If necessary concomitant orthognathic surgery can be done during this stage to correct any associated dentofacial deformities.

Pearce and colleagues⁶¹ described the use of preoperatively created templates to obviate the two-stage protocol described previously. Many surgeons agree that to realize all of the benefits afforded by a patient-fitted TMJ TJR device, the best fit for the components is achieved and ensured by using the two-stage protocol. The concern often raised about maintaining

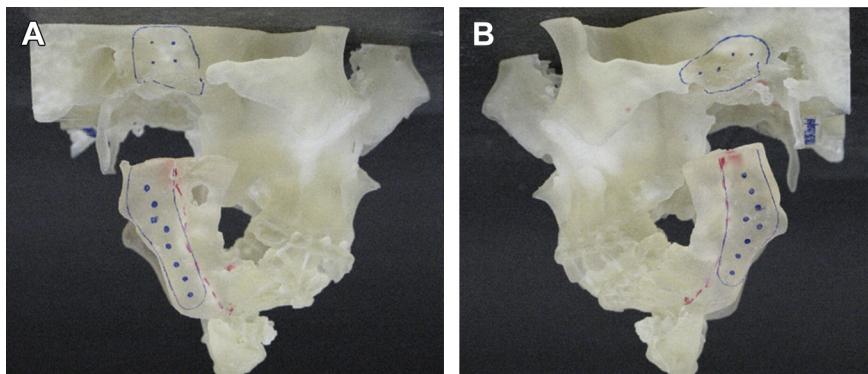


Fig. 5. (A, B) Stereolaser design models (ProtoMED, Westminster, CO) following stage 1 bilateral gap arthroplasties, insertion of spacer, and advancement genioplasty of patient in **Fig. 2**. (Courtesy of Dr Michael Bowler, Newcastle, New South Wales, Australia.)

maxillomandibular fixation between stages is moot because patients with ankylosis cannot open their mouths before the first-stage procedure.

One-stage surgeries could also be considered but require a more experienced surgeon that can reproduce the stereolithographic surgery in the patient to make the prosthesis fit. The benefit includes one surgery for the patient and immediate function with easier and faster rehabilitation (see **Fig. 3**).

IMPORTANCE OF FAT GRAFT IN PREVENTION OF HETEROtopic BONE FORMATION

The first reported use of autologous fat graft placement into the TMJ for the treatment of ankylosis was by Blair⁶² in 1913 followed by Murphy⁶³ in 1914. No other references appear in the literature

until the 1990s. In 1992, Wolford developed the technique of placing autogenous fat grafts around the TMJ Concepts to prevent postsurgical heterotopic bone and fibrosis development (**Fig. 3**). The rationale for placing autologous fat grafts around the TMJ TJR was to obliterate the dead space around the joint prosthesis, thus preventing the formation and subsequent organization of a blood clot. Creating this physical barrier serves to minimize the presence of pluripotential cells, and prevents the formation of extensive fibrosis and heterotopic calcification. The fat grafts may be inhibitory to heterotopic bone formation. It may also isolate any residual reactive tissue from previous alloplastic failure or disease to the periphery of the region, minimizing its formation around the joint components (**Fig. 3**).

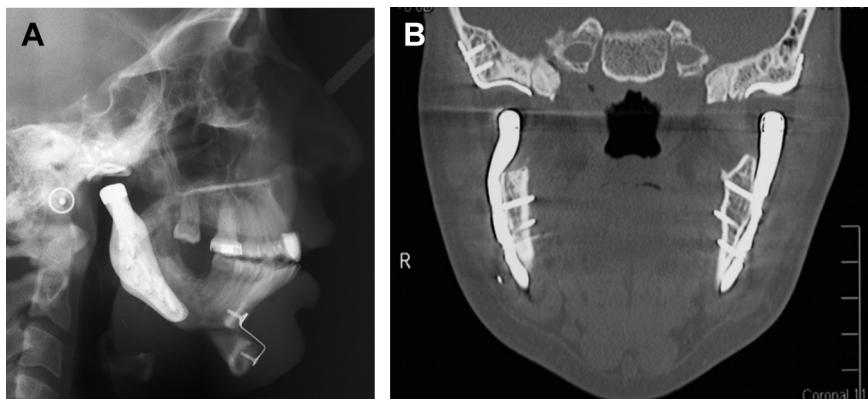


Fig. 6. (A, B) Lateral cephalometric and coronal CT post stage 2 implantation of TMJ Concepts (Ventura, CA) patient-fitted prostheses in patient in **Fig. 2**. The articulating aspect of the fossa component is ultra-high molecular weight polyethylene, therefore it is radiolucent. (Courtesy of Dr Michael Bowler, Newcastle, New South Wales, Australia.)



Fig. 7. (A, C) The patient in **Fig. 2** after dental rehabilitation, 5 years post bilateral TMJ Concepts patient-fitted replacements. (A) Post-surgery frontal view. (B) Post-surgery profile view. (C) Post-surgery maximum incisal opening of 42 mm with out pain. (Courtesy of Dr Michael Bowler, Newcastle, New South Wales, Australia.)

Wolford and Karras³⁵ published the first study evaluating fat grafts placed around TMJ total joint prostheses. Fifteen patients with 22 joints underwent TMJ reconstruction with TMJ Concepts/Techmedica patient-fitted TMJ TJR devices with autologous fat harvested from the abdomen packed around the articulating portion of the prostheses. There was no radiographic or clinical evidence of heterotopic calcifications in any of the fat grafted group, whereas seven control patients without fat grafts (35%) developed heterotopic bone and required reoperation. This initial study proved that autologous fat transplantation was a useful adjunct to alloplastic TMJ TJR by minimizing the occurrence of joint fibrosis and heterotopic calcification (see **Fig. 2**).

Mercuri and colleagues⁶⁰ evaluated 20 patients with 33 reankylosed TMJs managed with patient-fitted TMJ TJR devices and placement of periarticular autogenous abdominal fat grafts. Mean follow-up was 50.4 months. Results showed 52% reduction in pain, and improvement in jaw function (76%), diet (72%), and maximum incisal opening (MIO) (140%) from 11.75 mm to 32.9 mm, whereas 17 of 20 patients (85%) reported improvement in quality-of-life scores.

Autologous fat grafting is a useful adjunct to alloplastic TMJ TJR and may prove to be similarly beneficial in autologous TMJ TJR. Graft procurement is relatively quick and easy, with minimal morbidity.^{35,36} The most common complication found in the donor area was seroma or hematoma, which was treated with aspiration and pressure dressing. TMJ reconstruction with TMJ Concepts total joint prostheses and autogenous fat grafts

provides a highly predictable treatment method for patients with nonsalvageable TMJ pathology.

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